

Interview with a Lunatic:

Find out why Dr. Barbara Cohen is crazy about the moon

What is the moon made of? What natural resources are on the moon?

All the elements that are on the Earth are also present on the moon. These elements combine in the same ways to make minerals and rocks just like on the Earth. In fact, the two most common rocks on the moon are dark colored basalt, which is lava rock like we have in Hawaii, and makes up the dark areas of the moon, and white anorthosite, which is the white mineral found in granite, and which makes up the light-colored areas of the moon.

We usually think of a “natural resource” as a rare element that is concentrated in one place on the Earth, like a mine or a coal seam. The processes that concentrate elements on the Earth, like biological activity (coal, oil, natural gas) and water (mineral ores and oceans) do not operate on the moon. So we do not expect to find coal seams or metal ore deposits. However, sunlight is an abundant natural resource on the moon. One “day” on the moon lasts 14 Earth days, and near the poles there are places where the sun shines nearly all year long, making the moon a great place to get power from solar panels!

Is there water on the moon?

One of the most interesting things about the moon rocks returned by the astronauts is that they have no water in them. They are drier than any Earth rock you can imagine or could even make in a laboratory. This fact is an important piece of the puzzle in figuring out how the moon formed.

But after the moon formed dry, it experienced more than 4 billion years of being bombarded by wet objects. Pieces of comets and asteroids that contain ice continuously hit the moon and the water they carry might be able to stick around on the surface. Water molecules from the impacting objects may get trapped at the bottom of craters in permanent shadow, where the sun never shines and the surface is very, very cold. We don't think that there are smooth ice skating rinks in these craters, but there could be frost-covered dust grains or chunks of snowballs.

Water may be an important resource for humans living on the moon; therefore, we want to understand whether there is water, and how much is there. So we are sending the LCROSS and LRO missions.

Are there any organisms on the moon?

There is no life that is indigenous to the moon – that is, organisms that formed and grew up there. But, humans have sent several spacecraft to the moon. Spacecraft can carry billions of bacteria and other cells on them. Some organisms are known to be able to survive very harsh environments, at least for a little while. But the moon is harsher than

any Earth environment. An interesting experiment was performed when the Apollo 12 astronauts brought back some hardware from a robotic lunar mission, Surveyor III, that had landed about 3 years before. When the piece of that spacecraft came back to Earth, workers found bacteria on it that went from the Earth to the moon and back, and survived!

Will humans be able to live on the moon?

So far, humans have managed to live in the harshest, most remote, least liveable places on the Earth. We can spend days, months, even years in Antarctica, in the driest deserts, underwater, and even on the Space Station – if we have the basics of life: shelter, power, food, and water. Living on the moon will be a great challenge and will require a lot of skill and knowledge to make sure humans have these basic needs met, but we can definitely do it. Imagine waking up every day with a view of the planet Earth!

What is your favorite thing about the moon?

I have two favorite things. One is that the moon preserves so many impact craters on it for researchers like me to study. Did you know that all the craters you see on the moon (and there are hundreds of thousands of them!) had counterparts on the Earth at one point? Though, we don't see many impact craters on the Earth now. That's because the Earth's crust continually renews itself and erases old rocks and features. No rock on the Earth is older than about 4 billion years old. But the Earth definitely got beat up by impacts from comets and asteroids in its past – and that record is preserved for us to study on the moon. But, I also love that the moon looks so beautiful reflecting sunlight to us on dark nights.

How long is a day on the moon?

If you were living at the moon's equator, the time for the sun to come up, pass overhead, set, and rise again is 29.5 Earth days. You can see that by watching the moon pass through its phases – the phases occur as the sun rises and sets on the moon. For an outpost at the South Pole of the moon, though, the sun may not set all summer long, just like for people in the polar areas of the Earth. Probably moon-goers will stick to 24-hour Earth time and just get used to having the sun be up for 15 days in a row.

What is the largest crater on the moon?

The biggest and deepest crater on the moon is called the South Pole-Aitken Basin, or SPA for short. It stretches over 2200 km from the South Pole of the moon to a small crater named Aitken Crater on the other edge at nearly 30 degrees S longitude. If you were standing on the raised rim that encircles the crater, you would be 14 km above the crater floor! That's about the same as standing on Mt. Everest and looking into the deepest part of the ocean!

If you jump too high on the moon, will you float off into space?

Well, yes, but the same is true of the Earth, or anywhere. This is called escape velocity – the speed you need to jump to escape the gravitational field of whatever planet you're standing on. For the Earth, you could jump off if you were going 11 km per second – that's more than 24,000 miles per hour! No way can you jump that hard – that's why we need rockets to blast off the Earth into space. On the moon, the gravity is about one-sixth that of Earth, and escape velocity is about 4 km per second – but that is still about 9,000 miles per hour – way faster than you can make yourself jump before the moon reels you back in with its gravity.

How many moon rocks did astronauts bring back to Earth?

About 800 kg of moon rocks are on the Earth now that were brought back by U.S. astronauts. We also have 1 kg or so of rocks returned by robotic missions, three Luna landers sent by the former Soviet Union. That's a lot of rocks, and by studying them, we've learned a great deal about how the moon functions as a planet, and how it is like the Earth, Mars, and other rocky planets. But the thing is about the rocks, they all came from an area on the moon that represents less than 10% of the surface area of the moon. That's because of the safety restrictions on the human landing sites at the time. But it's also like going to the same U.S. state nine different times, and never going to the rest of the Earth. Think of what you might miss – the vast Pacific Ocean, the icy plateau of Antarctica, the high Himalaya mountains and the arid deserts of Africa. You'd know very little about how the Earth really was.

What we know now is that the moon has big areas that are very different from each other in composition and geology, and we'd like to have rocks from all these interesting areas, not just the Apollo sites. Fortunately, we also have some tens of kg of lunar meteorites. These are rocks knocked off the moon from random places that fall to the Earth. We can't pinpoint where they came from, but we know a lot more about the whole moon from them combined with the Apollo and Luna rocks. When we return to the moon, one of the things scientists would like is to collect samples from different places on the moon. When we study rocks in the laboratory, we learn about the moon's formation and history.